 

**CSC2106 Internet of Things: Protocols and Networks [2023/24 T2]**

Literature Review (Individual)

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## 1. Introduction

The Smart Tracker project focuses on developing a comprehensive Smart Warehouse Inventory Tracker for indoor environments. The system aims to provide precise location information, catering to applications such as indoor asset tracking in warehouses. Utilising communication protocols, such as Bluetooth Low Energy (BLE) or WiFi, and microcontroller units (MCUs) such as M5StickC Plus, Super Mini ESP32-C3, and Raspberry Pi Pico, the project aims to demonstrate real-time tracking capabilities.

## 2. Problem Statement

The Smart Warehouse Inventory Tracker project aims to rectify the inherent limitations of

contemporary IoT sensors, particularly concerning their efficacy in detecting objects in a vertical

orientation within the intricate dimensions of a 3D indoor space. This deficiency becomes particularly pronounced and operationally challenging in vertical tracking scenarios, notably when applied to the precision monitoring tools within a workshop environment. Recognising the urgency to overcome these limitations, the project introduces an innovative solution that augments the sensor network, strategically increasing the number of nodes. This augmentation aims not only to bolster tracking accuracy but also to hone in on the nuanced demands of vertical tracking within the specific context of workshop tools.

Key Points:

* Vertical Tracking Limitation: The prevailing generation of IoT sensors grapples with challenges in effectively detecting objects oriented vertically within the intricate spatial landscape of a 3D indoor environment. This limitation poses a substantial impediment to achieving precise and reliable tracking outcomes.
* Enhanced Accuracy: The proposed solution unfolds as a meticulous strategy involving a discerning increase in the number of nodes within the sensor network. This deliberate augmentation is envisaged as a cornerstone for achieving a paradigm shift in tracking accuracy, transcending the constraints imposed by current sensor limitations.
* Workshop Tool Tracking: A focal point of this initiative is the tailored attention given to the tracking of tools within the dynamic setting of a workshop environment. Recognising the unique challenges presented by workshop scenarios, the solution aims to elevate the accuracy and reliability of tracking specifically for tools, thereby addressing a critical operational need.
* Scalability Consideration: The design philosophy underpinning the proposed solution is inherently forward-looking, with scalability positioned as a paramount consideration. Beyond immediate requirements, the solution is meticulously crafted to seamlessly expand and adapt to the evolving demands of future expansions, ensuring sustained relevance and operational efficiency.

## 3. Literature Review: *Existing Solutions for Tool Tracking in Construction Sites*

Efficient tool management is essential in construction sites to mitigate losses and enhance project success. The paper proposes a Radio-Frequency Identification (RFID) based tool and inventory tracking system to address these challenges.  
  
*RFID Technology*: The system utilizes RFID tags, readers, sensors, batteries, microcontrollers, ESP8266, and Node MCU for traceability and real-time tracking of tools (Agarwal et al., 2018). While RFID offers advantages in scalability and real-time tracking, its effectiveness may be limited by metal interference in construction environments.  
  
*Integration with Sensor Networks*: Integration with sensor networks, including Kalman filters and fuzzy expert systems, enhances tracking accuracy (Agarwal et al., 2018). However, the complexity of integrating multiple IoT protocols may pose challenges in deployment and maintenance.  
  
*RFID Tagging and Data Management*: RFID tagging, facilitated by portals and mobile scanners, serves as a data backbone for tracking tools (Agarwal et al., 2018). However, challenges such as economics, standardization, and tag range limitations may hinder widespread adoption.

*Comparative Analysis of Tracking Algorithms*: Comparative analysis of tracking algorithms provides insights into their performance in real-time asset tracking (Agarwal et al., 2018). However, the effectiveness of these algorithms in dynamic construction environments remains to be fully validated.

While RFID technology shows promise in addressing tool management challenges in construction sites, limitations such as metal interference and deployment complexities must be considered. Further research is needed to optimize RFID systems for construction environments and overcome existing limitations in scalability, standardization, and data management.

## 4. References

Agarwal, A., Tanwar, A., Singh, R., Garg, V., Gehlot, A. (2018). Arduino- and IoT-Based Tools and Inventory Tracking System in Construction Sites. In: Singh, R., Choudhury, S., Gehlot, A. (eds) Intelligent Communication, Control and Devices. Advances in Intelligent Systems and Computing, vol 624. Springer, Singapore. <https://doi-org.singaporetech.remotexs.co/10.1007/978-981-10-5903-2_173>